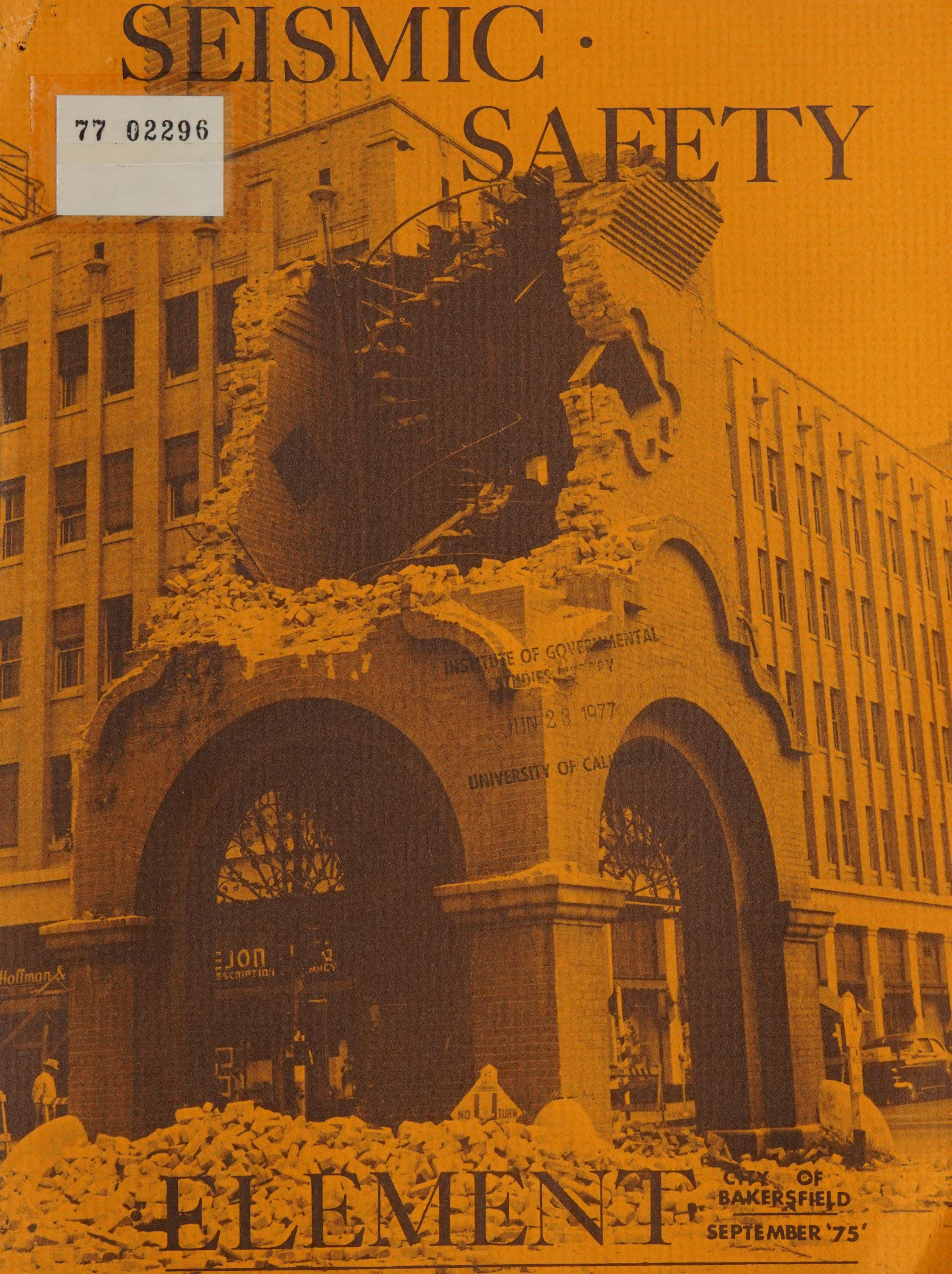


SEISMIC · SAFETY

77 02296



ELEMENT

CITY OF
BAKERSFIELD
SEPTEMBER '75'



ROCK TYPES:

Younger Sediments (Pleistocene and younger) ----- Ys
Older Sediments (Pliocene and Older) ----- Os
Crystalline Rocks (Igneous and Metamorphic) ----- Cr

ROCK STRUCTURE:

Zone of Faulting -----
Surface Faulting -----
Faults Showing Creep -----
Faults that displace Younger Sediments or show other evidence of recent movement -----
Surface Faults Inferred - exact location unknown -----
Subsurface Faults -----
Subsurface Faults Inferred - exact location unknown -----
Contacts other than Fault Contacts
Observed -----
Inferred -----
Uncertain Contacts ----- ?

SENSE of FAULTS:

Relative movement of fault
Up U 700' VERTICAL DISPLACEMENT IN FEET
Down D 300' VERTICAL DISPLACEMENT IN FEET
Right 800' HORIZONTAL DISPLACEMENT IN FEET
Left 300' HORIZONTAL DISPLACEMENT IN FEET
Dip angle 60° DIP ANGLE IN DEGREES

FOLDS:

Anticline normal overturned
Syncline normal overturned
Dip Strike normal overturned vertical
Concealed or subsurface folds are shown as

LANDSLIDE:

EARTHQUAKE EPICENTERS:

SEISMICITY AND STRAIN RELEASE: When two or more earthquakes have occurred at the same average location (epicenter) one symbol representing the sum of the individual strain releases during these earthquakes is shown on this map with a subscript number equal to the number of quakes at that location during the years for which the data are available (1932-1971). (Example: Strain release sum = 96.14, number of quakes = 5, value from N₂ table = 5.2, symbol is -⊕₅).

SYMBOL RICHTER MAGNITUDE

○	2.9 or less
○	3.0 to 3.9
○	4.0 to 4.9
○	5.0 to 5.9
○	6.0 to 6.9
○	7.0 or greater

SOURCE: FIELD WORK BY GARNER, PITMAN & W. H. PARK
DIV. OIL & GAS - VOL. 51 NO. 2 (1965); VOL. 45 NO. 2 (1959); VOL. 47 NO. 2 (1961)
REFER TO THE TEXT OF THE SEISMIC SAFETY ELEMENT FOR EXPLANATION OF TERMS.

ALTERATIONS			INDEX MAP OF KERN COUNTY
NO.	DATE	REMARKS	

THE KERN COUNTY COUNCIL OF GOVERNMENTS, THROUGH LETTERS OF AGREEMENT WITH THE COUNTY OF KERN AND EACH OF THE ELEVEN INCORPORATED CITIES, HAS CONTRACTED WITH CONSULTANTS IN THE FIELD OF EARTH SCIENCE FOR THE PREPARATION OF THIS MAP.

INFORMATION SHOWN ON THIS MAP WAS COMPILED FOR KERN COUNTY COUNCIL OF GOVERNMENTS UNDER CONTRACT WITH THE UNDERSIGNED CONSULTANT, ASSISTED BY GEOLOGIST TARRANT BROOKS. THEY PERFORMED THE COMPILED TO THE BEST OF THEIR ABILITY, USING ALL DATA AND INFORMATION AVAILABLE TO THEM DURING THE TERM OF THE CONTRACT. WHERE POSSIBLE, THE INFORMATION HAS BEEN CHECKED AND TO THE BEST OF THEIR KNOWLEDGE, THEY HAVE INCLUDED ALL FEATURES KNOWN TO THEM WHICH HAVE A DIRECT BEARING ON SEISMIC AND GEOLOGIC HAZARDS, INCLUDING LANDSLIDING AND SUBSIDENCE.

William H. Park
WILLIAM H. PARK, GEOLOGIST
REGISTRATION NO. 2271 STATE OF CALIFORNIA

THIS MAP HAS BEEN CHECKED AND REVISED AND TO THE BEST OF THE UNDERSIGNED CONSULTANTS KNOWLEDGE EXPRESSES THOSE ELEMENTS OF FAULTING, SEISMIC AND GEOLOGIC HAZARDS THAT BEAR UPON THE MATTER OF PUBLIC SAFETY UNDER THE SEISMIC SAFETY ELEMENT OF THE GENERAL PLAN. IT IS TO BE UNDERSTOOD THAT ALL HAZARDS HAVE NOT AS YET BEEN RECOGNIZED, AND HENCE SOME ARE UNDOUBTEDLY OMITTED FROM THIS MAP.

Pierre Saint-Amant
PIERRE SAINT-AMANT, PH.D.
TECHNICAL CONSULTANT
REGISTRATION NO. 2919 STATE OF CALIFORNIA

René Engel
RENE ENGEL, PH.D., CH.E.
TECHNICAL CONSULTANT
REGISTRATION NO. 1882 STATE OF CALIFORNIA

SEISMIC HAZARD

ATLAS

5 CI

OILDALE

KERN COUNTY, CALIFORNIA

PREPARED FOR
KERN COUNTY COUNCIL OF GOVERNMENTS

DRAWN BY: KERN COUNTY PLANNING DEPARTMENT

Map, edited, and published by the Geological Survey
Control by USGS and USC&GS
Topography from aerial photographs by photogrammetric methods
and by plane-table surveys 1954. Aerial photographs taken 1952
Polyconic projection. 1927 North American datum
10,000-foot grid based on California coordinate system, zone 5
Red tint indicates areas in which only landmark buildings are shown
1000-meter Universal Transverse Mercator grid ticks,
zone 11, shown in blue. This information not field checked
Revisions shown in purple compiled from aerial photographs
taken 1968. This information not field checked
Purple tint indicates extension of urban areas
Possible southerly extension of Premier Fault.

CONTOUR INTERVAL 10 FEET
DASHED LINES REPRESENT HALF-INTERVAL CONTOURS
DATUM IS MEAN SEA LEVEL

FOR SALE BY U.S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR WASHINGTON, D. C. 20242
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

OILDALE, CALIF.
NE 1/4 BAKERSFIELD WEST 15' QUADRANGLE
N 3527.5 W 11900.77 R

1954
PHOTOREVISED 1968
AMS 2154 1 NE-SERIES 1985

77 02296
Map 1 of 4

Zone of Faulting -----

Surface Faulting -----

Faults Showing Creep -----

Faults that displace Younger Sediments or
show other evidence of recent movement -----

Surface Faults Inferred - exact location unknown -----

Subsurface Faults -----

Subsurface Faults Inferred - exact location unknown -----

Contacts other than Fault Contacts

 Observed -----

 Inferred -----

Uncertain Contacts -----

Relative movement of fault

Up U 700 VERTICAL DISPLACEMENT IN FEET

Down D

Right $\Rightarrow$ 500 FAULT HORIZONTAL DISPLACEMENT IN FEET

Left $\Leftarrow$ 300 FAULT

Dip angle $\searrow$ 60° DIP ANGLE IN DEGREES

Anticline	normal	
	overturned	
Syncline	normal	
	overturned	
Dip Strike	normal	
	overturned	
	vertical	
Concealed or subsurface folds are shown as		

SEISMICITY AND STRAIN RELEASE: When two or more earthquakes have occurred at the same average location (epicenter) one symbol representing the sum of the individual strain releases during these earthquakes is shown on this map with a subscript number equal to the number of quakes at that location during the years for which the data are available (1932 - 1971). (Example: Strain release sum = 96.14, number of quakes = 5, value from N_2 table = 5.2, symbol is $\oplus_{5.2}$.)

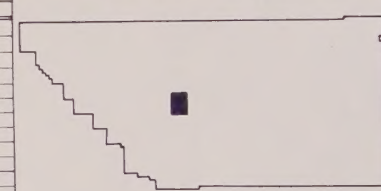
<u>SYMBOL</u>	<u>RICHTER MAGNITUDE</u>
	2.9 or less
	3.0 to 3.9
	4.0 to 4.9
	5.0 to 5.9
	6.0 to 6.9
	7.0 or greater.

SOURCE: BAKERSFIELD GEOLOGIC SHEET, DIV. MINES & GEOLOGY;
FRUITVALE OILFIELD-DIV. OIL & GAS, VOL. 51 NO. 2 (1965)

REFER TO THE TEXT OF THE SEISMIC SAFETY ELEMENT FOR EXPLANATION OF TERMS

NO.	DATE	Sec T/R	REMARKS

INDEX MAP of KERN COUNTY



THE KERN COUNTY COUNCIL OF GOVERNMENTS, THROUGH LETTERS OF AGREEMENT WITH THE COUNTY OF KERN AND EACH OF THE ELEVEN INCORPORATED CITIES, HAS CONTRACTED WITH CONSULTANTS IN THE FIELD OF EARTH SCIENCE FOR THE PREPARATION OF THIS MAP

INFORMATION SHOWN ON THIS MAP WAS COMPILED FOR KERN COUNTY COUNCIL OF GOVERNMENTS UNDER CONTRACT WITH THE UNDERSIGNED CONSULTANT, ASSISTED BY GEOLOGIST TENNANT-BROOKS. THEY PERFORMED THE COMPILATION TO THE BEST OF THEIR ABILITY, USING ALL DATA AND INFORMATION AVAILABLE TO THEM DURING THE TERM OF THE CONTRACT. WHERE POSSIBLE, THE INFORMATION HAS BEEN CHECKED AND TO THE BEST OF THEIR KNOWLEDGE, THEY HAVE INCLUDED ALL FEATURES KNOWN TO THEM WHICH HAVE A DIRECT BEARING ON SEISMIC AND GEOLOGIC HAZARDS, INCLUDING LANDSLIDING AND SUBSIDENCE.

WILLIAM H. PARK, GEOLOGIST
REGISTRATION NO. 2271 STATE OF CALIFORNIA

THIS MAP HAS BEEN CHECKED AND REVISED AND TO THE BEST OF THE UNDERSIGNED CONSULTANTS' KNOWLEDGE EXPRESSES THOSE ELEMENTS OF FAULTING, SEISMIC AND GEOLOGIC HAZARDS THAT BEAR UPON THE MATTER OF PUBLIC SAFETY UNDER THE SEISMIC SAFETY ELEMENT OF THE GENERAL PLAN. IT IS TO BE UNDERSTOOD THAT ALL HAZARDS HAVE NOT AS YET BEEN RECOGNIZED AND HENCE SOME ARE UNDOUBTEDLY OMITTED FROM THIS MAP.

PIERRE SAINT-AMAND, PH.D.
TECHNICAL CONSULTANT
REGISTRATION NO 2919 STATE OF CALIFORNIA

RENE ENGEL PH.D., CH.E.
TECHNICAL CONSULTANT
REGISTRATION NO. 1882 STATE OF CALIFORNIA

KERN COUNTY, CALIFORNIA

PREPARED FOR
KERN COUNTY COUNCIL OF GOVERNMENTS

DRAWN BY-KERN COUNTY PLANNING DEPARTMENT

77 02296
Map 2 of 4





ROCK TYPES:

Younger Sediments (Pleistocene and younger) ----- Ys
 Older Sediments (Pliocene and Older) ----- Os
 Crystalline Rocks (Igneous and Metamorphic) ----- Cr

ROCK STRUCTURE:

Zone of Faulting -----
 Surface Faulting -----
 Faults Showing Creep -----
 Faults that displace Younger Sediments or show other evidence of recent movement -----
 Surface Faults Inferred - exact location unknown -----
 Subsurface Faults -----
 Subsurface Faults Inferred - exact location unknown -----
 Contacts other than Fault Contacts
 Observed -----
 Inferred -----
 Uncertain Contacts ----- ?

SENSE of FAULTS:

Relative movement of fault
 Up -----
 Down -----
 Right -----
 Left -----
 Dip angle -----

FOLDS:

Anticline normal overturned
 Syncline normal overturned
 Dip Strike normal overturned vertical
 Concealed or subsurface folds are shown as

LANDSLIDE:

EARTHQUAKE EPICENTERS:

SEISMICITY AND STRAIN RELEASE When two or more earthquakes have occurred at the same average location (epicenter) one symbol representing the sum of the individual strain releases during these earthquakes is shown on this map with a subscript number equal to the number of quakes at that location during the years for which the data are available (1932-1971). (Example: Strain release sum = 96.14, number of quakes = 5, value from N₅ table = 5.2, symbol is - 5.2).

SOURCE: DIV. OIL & GAS - VOL. 36 NO. 1; TSM VOL. 38 NO. 2; SURFACE GEOL. - MAP NO. 3
 REFER TO THE TEXT OF THE SEISMIC SAFETY ELEMENT FOR EXPLANATION OF TERMS.

ALTERATIONS			INDEX MAP of KERN COUNTY
NO.	DATE	REMARKS	

THE KERN COUNTY COUNCIL OF GOVERNMENTS, THROUGH LETTERS OF AGREEMENT WITH THE COUNTY OF KERN AND EACH OF THE ELEVEN INCORPORATED CITIES, HAS CONTRACTED WITH CONSULTANTS IN THE FIELD OF EARTH SCIENCE FOR THE PREPARATION OF THIS MAP.

INFORMATION SHOWN ON THIS MAP WAS COMPILED FOR KERN COUNTY COUNCIL OF GOVERNMENTS UNDER CONTRACT WITH THE UNDERSIGNED CONSULTANT, ASSISTED BY GEOLOGIST TENANT BROOKS. THEY PERFORMED THE COMPILED TO THE BEST OF THEIR ABILITY, USING ALL DATA AND INFORMATION AVAILABLE TO THEM DURING THE TERM OF THE CONTRACT. WHERE POSSIBLE, THE INFORMATION HAS BEEN CHECKED AND TO THE BEST OF THEIR KNOWLEDGE, THEY HAVE INCLUDED ALL FEATURES KNOWN TO THEM WHICH HAVE A DIRECT BEARING ON SEISMIC AND GEOLOGIC HAZARDS, INCLUDING LANDSLIDING AND SUBSIDENCE.

William H. Park, GEOLOGIST
 REGISTRATION NO. 2271 STATE OF CALIFORNIA

THIS MAP HAS BEEN CHECKED AND REVISED AND TO THE BEST OF THE UNDERSIGNED CONSULTANTS KNOWLEDGE EXPRESSES THOSE ELEMENTS OF FAULTING, SEISMIC AND GEOLOGIC HAZARDS THAT BEAR UPON THE MATTER OF PUBLIC SAFETY UNDER THE SEISMIC SAFETY ELEMENT OF THE GENERAL PLAN. IT IS TO BE UNDERSTOOD THAT ALL HAZARDS HAVE NOT AS YET BEEN RECOGNIZED AND HENCE SOME ARE UNDOUBTEDLY OMITTED FROM THIS MAP.

Pierre Saint-Amant, PH.D., CH.E. TECHNICAL CONSULTANT
 REGISTRATION NO. 2919 STATE OF CALIFORNIA
 Rene Engel, PH.D., CH.E. TECHNICAL CONSULTANT
 REGISTRATION NO. 1882 STATE OF CALIFORNIA

SEISMIC HAZARD ATLAS 6C2 OIL CENTER KERN COUNTY, CALIFORNIA

PREPARED FOR
 KERN COUNTY COUNCIL OF GOVERNMENTS

DRAWN BY: KERN COUNTY PLANNING DEPARTMENT

Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Topography from aerial photographs by multi-frames methods and by plane table surveys 1954. Aerial photographs taken 1952

Polyconic projection. 1927 North American datum. 10,000-foot grid based on California coordinate system, zone 5.

Red tint indicates areas in which only landmark buildings are shown.

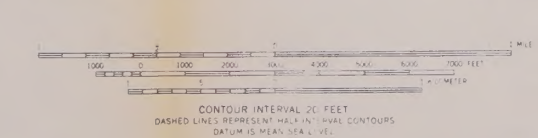
Dashed land lines indicate approximate locations.

Unchecked elevations are shown in brown.

1000-meter Universal Transverse Mercator grid ticks.

Reasons shown in purple compiled from aerial photographs taken 1968. This information not field checked.

Purple tint indicates extension of urban areas.



THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
 FOR SALE BY U.S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225 OR WASHINGTON, D.C. 20242
 A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

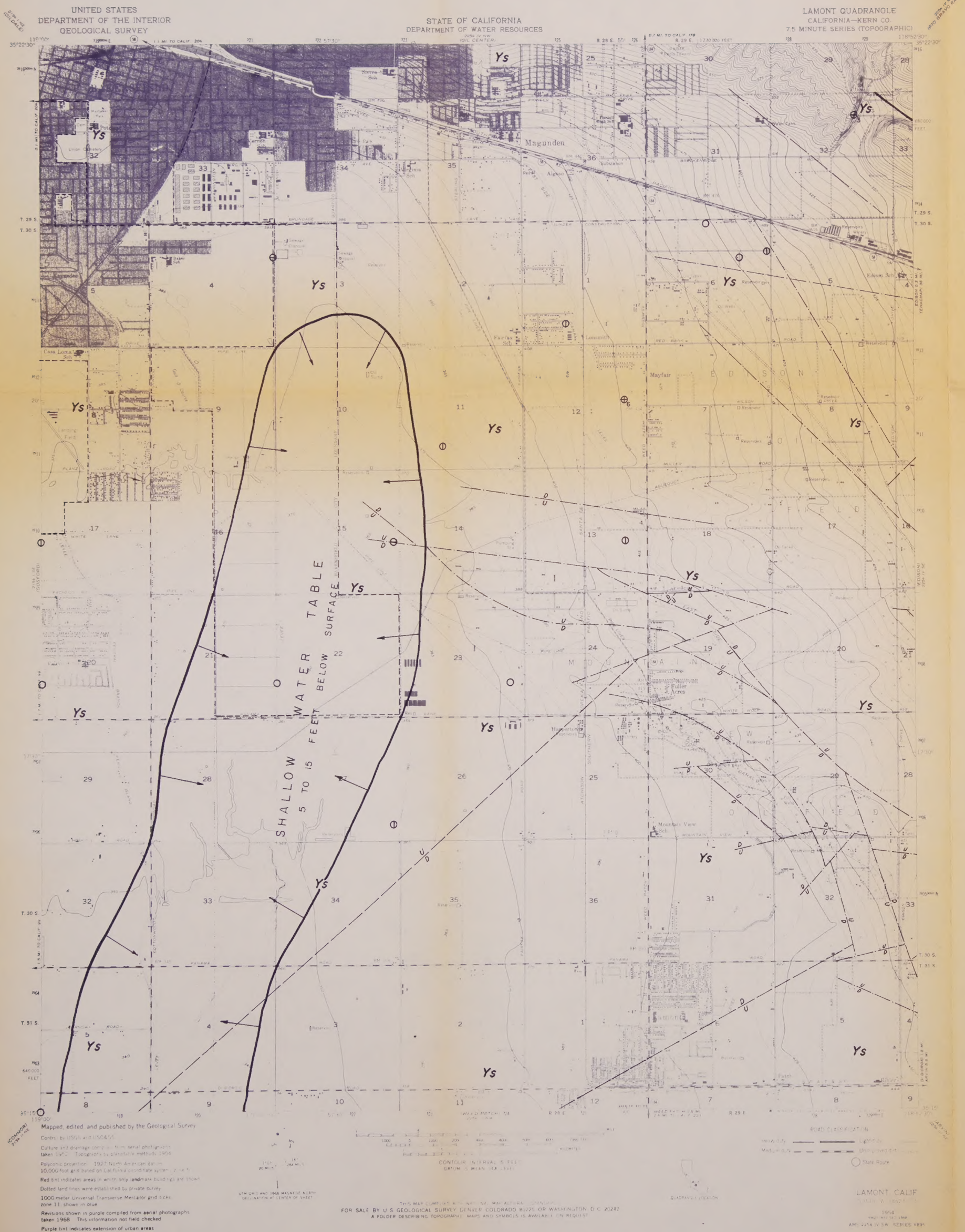
OIL CENTER, CALIF.

N 3522 5 - W 11852 5 / 7.5

1954

AMS 2254 IV NW - SERIES V85

77 02296
 Map 3 of 4



ROCK TYPES:

Younger Sediments (Pleistocene and younger) ———— Ys
Older Sediments (Pliocene and Older) ———— Os
Crystalline Rocks (Igneous and Metamorphic) ———— Cr

ROCK STRUCTURE:

Zone of Faulting ————
Surface Faulting ————
Faults Showing Creep ————
Faults that displace Younger Sediments or
show other evidence of recent movement ————
Surface Faults Inferred—exact location unknown ————
Subsurface Faults ————
Subsurface Faults Inferred—exact location unknown ————
Contacts other than Fault Contacts
Observed ————
Inferred ————
Uncertain Contacts ———— ?

SENSE of FAULTS:

Relative movement of fault
Up U 700 VERTICAL DISPLACEMENT IN FEET
Down D 700 VERTICAL DISPLACEMENT IN FEET
Right 100 HORIZONTAL DISPLACEMENT IN FEET
Left 100 HORIZONTAL DISPLACEMENT IN FEET
Dip angle 100 DIP ANGLE IN DEGREES

FOLDS:
Anticline normal overturned
Syncline normal overturned
Dip Strike normal overturned vertical
Concealed or subsurface folds are shown as

LANDSLIDE:

EARTHQUAKE EPICENTERS:

SEISMICITY AND STRAIN RELEASE: When two or more earthquakes have occurred at the same average location (epicenter) one symbol representing the sum of the individual strain releases during these earthquakes is shown on this map with a subscript number equal to the number of quakes at that location during the years for which the data are available (1932-1971). (Example: Strain release sum = 96.14, number of quakes = 5, value from N₃ table = 5.2, symbol is 96.14/5).

SYMBOL RICHTER MAGNITUDE
2.9 or less
3.0 to 3.9
4.0 to 4.9
5.0 to 5.9
6.0 to 6.9
7.0 or greater.

SOURCE: DIV. OIL & GAS VOL. 52 NO. 1 & VOL. 26; KERN CO. WATER AGENCY;
MAP NO. 11; GEOLOGIC MAP OF CALIF., BAKERSFIELD SHEET, DIV. MINES & GEOLOGY.

REFER TO THE TEXT OF THE SEISMIC SAFETY ELEMENT FOR EXPLANATION OF TERMS.

ALTERATIONS				INDEX MAP OF KERN COUNTY
NO.	DATE	SEC./TR.	REMARKS	

THE KERN COUNTY COUNCIL OF GOVERNMENTS, THROUGH LETTERS OF AGREEMENT WITH THE COUNTY OF KERN AND EACH OF THE ELEVEN INCORPORATED CITIES, HAS CONTRACTED WITH CONSULTANTS IN THE FIELD OF EARTH SCIENCE FOR THE PREPARATION OF THIS MAP.

INFORMATION SHOWN ON THIS MAP WAS COMPILED FOR KERN COUNTY COUNCIL OF GOVERNMENTS UNDER CONTRACT WITH THE UNDERSIGNED CONSULTANT, ASSISTED BY GEOLOGIST TENNANT BROOKS. THEY PERFORMED THE COMPILATION TO THE BEST OF THEIR ABILITY, USING ALL DATA AND INFORMATION AVAILABLE TO THEM DURING THE TERM OF THE CONTRACT. WHERE POSSIBLE, THE INFORMATION HAS BEEN CHECKED AND TO THE BEST OF THEIR KNOWLEDGE THEY HAVE INCLUDED ALL FEATURES KNOWN TO THEM WHICH HAVE A DIRECT BEARING ON SEISMIC AND GEOLOGIC HAZARDS, INCLUDING LANDSLIDING AND SUBSIDENCE.

William H. Park, Geologist
REGISTRATION NO. 2271 STATE OF CALIFORNIA

THIS MAP HAS BEEN CHECKED AND REVISED AND TO THE BEST OF THE UNDERSIGNED CONSULTANTS' KNOWLEDGE EXPRESSES THOSE ELEMENTS OF FAULTING, SEISMIC AND GEOLOGIC HAZARDS THAT BEAR UPON THE MATTER OF PUBLIC SAFETY UNDER THE SEISMIC SAFETY ELEMENT OF THE GENERAL PLAN. IT IS TO BE UNDERSTOOD THAT ALL HAZARDS HAVE NOT AS YET BEEN RECOGNIZED AND HENCE SOME ARE UNDOUBTEDLY OMITTED FROM THIS MAP.

Pierre Saint-Amant, Ph.D.
TECHNICAL CONSULTANT
REGISTRATION NO. 2919 STATE OF CALIFORNIA

René Enel, Ph.D., Ch.E.
TECHNICAL CONSULTANT
REGISTRATION NO. 1882 STATE OF CALIFORNIA

SEISMIC HAZARD ATLAS 6 C 3 LAMONT

KERN COUNTY, CALIFORNIA

PREPARED FOR
KERN COUNTY COUNCIL OF GOVERNMENTS

DRAWN BY: KERN COUNTY PLANNING DEPARTMENT

77 02296
Map 4 of 4

Kern county council of govts]
city planning Buttefield
Energy relief Earthquakes "

SEISMIC SAFETY ELEMENT

A. INTRODUCTION

Believe it or not, there are people living in other parts of the country who may be subjected to the dangers of destructive floods and hurricanes, but who wouldn't consider living in California because of their fear of EARTHQUAKES! This fear is perpetuated by widespread news coverage of periodic earthquakes, occasional documentaries concerning the hazards of seismic activity, and at least one major motion picture ("Earthquake").

That's not to say that earthquakes do not pose real hazards to life and property--they do. Over the last 100 years, the economic loss from the direct and indirect effects of seismic activity within the State is estimated to be \$6.54 billion. During the San Fernando Valley earthquake of February 9, 1971, sixty-four persons died and \$535 million in property was lost. Closer to home, the Kern County earthquakes during the summer of 1952 resulted in fourteen deaths and \$60,000,000 in property loss in the Southern San Joaquin Valley.

To a substantial degree, the deaths and destruction resulting from seismic activity can be avoided--through land use planning, building controls, and awareness of the public of "what to do" in the event of earthquakes. For these reasons, the California State Legislature enacted, in 1971, legislation requiring a Seismic Safety Element as part of the general plans of all cities and counties (Section 65302(f) of the Government

Code). The Seismic Safety Element is to consist of an identification and appraisal of seismic hazards, such as susceptibility to surface ruptures from faulting, to ground shaking, to ground failure, or to the effects of seismically induced water waves such as seiches (oscillation of water in a lake).

It is appropriate that a plan which addresses the hazards of seismic activities be adopted at the local level, for the following reasons:

1. The geology of various portions of the State differs substantially. The adoption of Seismic Safety Elements at the local level enables consideration of the unique characteristics of a given locality.
2. With only a few exceptions, the "degree of risk" which a given locality chooses to accept may be geared to local geologic and seismic hazard data.
3. Local governments will be responsible for implementing Seismic Safety Elements. The strategies for implementation may, thus, be tailored to existing governmental planning processes.

This Seismic Safety Element has been prepared in compliance with Section 65302(f) of the State of California Government Code and the guidelines developed by the Council on Intergovernmental Relations. It is concerned with the prospects for earthquakes and various related geographic phenomena within the City of Bakersfield and the immediate environment; and the statements of objectives, policies and implementation programs



Digitized by the Internet Archive
in 2025 with funding from
State of California and California State Library

<https://archive.org/details/C101738914>

which the City may undertake to protect the health and welfare of its people from seismic activity.

B. REFERENCES AND ACKNOWLEDGEMENTS

This report is a simplified summary of a much more detailed study undertaken by the Kern County Council of Governments (KernCOG). Technical studies in the fields of geology and seismology were done by Dr. Pierre Saint-Amand, Dr. Rene' Engel, and Mr. William Park, who worked for KernCOG under contract. The coordinator of the study was Mr. Brad Williams of KernCOG. We gratefully acknowledge the contribution of KernCOG, its able staff, and the consultants they retained.

The KernCOG study resulted in three products which may be studied by those more concerned with the technical aspects of the Seismic Safety Element. These products are:

1. "Geology and Earthquake Hazards Planning Guide to the Seismic Safety Elements for Kern County," which is a comprehensive study and evaluation of available seismic information.
2. "Seismic Safety Element," a kind of "boiler plate" document put together by KernCOG, based on the above mentioned study, which may be massaged by cities for adoption. That's basically what we have done here, except that the size and complexity of the report have been substantially reduced.
3. "Seismic Hazard Atlas" composed of maps showing geographic features, such as faults, for use along with statements

within the text of the studies. These maps will enable developers and responsible City departments to identify areas of known seismic risk, so that safeguards can be taken to protect the people and property.

KernCOG and the authors of the Seismic Element Study openly admit the limitations of the study. Users are cautioned not to make decisions about a specific location on the basis of the study alone; additional on-site geologic investigation may be necessary. The information from the Seismic Element Study is a good "early warning" of where problems may be anticipated. The limitations on the use of the study exist because of the limited completeness and accuracy of the geologic investigations that have been done in this area.

C. SUMMARY OF RECOMMENDATIONS

Objective: To prevent or at least reduce the loss of life, injuries, property damage and social and economic dislocation resulting from future earthquakes.

Recommendations:

1. Land Use Planning

- a. Special geologic studies should be undertaken within the vicinity of bluff areas and in the vicinity of the southeast sewer farm to determine the extent of potential seismic hazards, if any. If such studies determine that seismic problems may be anticipated, specific land use plans should be prepared for

these areas specifying appropriate future land uses, geared to the anticipated degree of risk, and any necessary site development criteria.

- b. Coordinate redevelopment planning and activity with the Hazard Abatement Plan.

2. The Role of the Building Department

- a. Prepare a Hazard Abatement Plan to investigate and abate existing dangerous buildings within the community, including the demolition and/or renovation of dangerous buildings in accordance with a priority timetable.
- b. Continue to adopt and enforce up-to-date building and related codes to achieve an adequate measure of safety in new construction.

3. Disaster Contingency Plans

- a. Be prepared for seismic emergencies by actively following existing and future disaster contingency plans.

4. Continuing Research

- a. Support local, state, and federal programs for research on seismic activity, toward the ultimate development of realistic, economic, and safe construction and land use techniques.

5. Self-help

- a. Encourage community-wide educational programs to inform people what they can do to help themselves before, during, and after earthquakes.

D. WHAT ARE EARTHQUAKES AND THEIR RELATED EFFECTS

An "earthquake" may be defined as perceptible trembling, to violent shaking, of the ground caused by a sudden displacement of rocks below the ground.

Stated very simply, the earth's crust or outer shell is subject to movement all the time. But, earth and subsurface rock formations generally do not move easily; they withstand pressures until the stresses overcome the strength of the rock. When movement does occur, it usually does so suddenly along faults, or cracks, in the earth's crust. That sudden movement causes the shaking or trembling--an "earthquake."

The magnitude of an earthquake depends upon the amount of energy released during the movement. The Richter Scale is a measurement of the magnitude of earthquakes. It is a "logarithmic" scale from 1 to 10, which means that every increase in a number (e.g., 3 to 4) is really a ten-fold increase in the intensity of an earthquake; an earthquake of magnitude 10 is 10 million times greater than an earthquake of magnitude one. In terms of the energy measured by the Richter Scale, 1.5 indicates the smallest earthquake that can be felt, 4.5 an earthquake causing slight damage, and 8.5 a very devastating earthquake. The magnitude of an earthquake is the measurement of the energy released at the center, or epicenter, of an earthquake.

Earthquakes are generally the result of deep-seated movement within the earth's crust (8± miles from the surface).

However, large movements may be accompanied by actual rupture, slip or folding of the earth's surface. Damage from such surface movement can certainly occur, but such damage would generally be localized. The most pervasive damage generally occurs, however, from ground-shaking.

The intensity of ground-shaking generally becomes less severe as the distance from the fault increases, although exceptions may occur as a result of certain geologic characteristics. Ground-shaking can be very destructive. Older buildings which have not been designed to withstand earthquakes may either be totally destroyed or substantially damaged by an earthquake of substantial intensity (VI+ on the Modified Mercalli Scale). Building overhangs such as decorative cornices and parapets; false walls extending above the top floor, which were commonly used architectural features of older buildings; can fall during earthquakes causing injury or death to people below. Older brick buildings which have not been reinforced to withstand earthquakes are probably most prone to failure or damage. One or two-story wood framed buildings are probably the safest. Of course, tall buildings are more subject to earthquake damage and injury to people than one or two-story buildings, although modern building practices make possible the construction of tall buildings which are relatively safe from earthquakes.

Relatively low magnitude earthquakes can trigger landslides where there are cliffs or along slopes where soils are not stable. Large magnitude earthquakes can trigger landslides

on relatively shallow slopes if lateral acceleration forces are substantial. For example, an earthquake of magnitude 6.6 can create lateral forces equal to 0.65 gravity at two miles from the epicenter. Where landslides or tilting of the earth may occur during seismic activity, erosion may also occur.

Earthquakes may also result in a phenomenon termed "liquefaction." This may occur within areas where a shallow water table exists. Liquefaction is groundwater being forced into or through the pores of soils or sand. In some cases it may result in water spouts which could virtually wash buildings off their foundations. In other cases groundwater may mix with sands or soils, thus making them incapable of supporting foundations. Liquefaction may also cause subsidence where soils are reactive to water and permit the settlement of buildings. For example, clay lenses with perched water tables may become plastic, and thus fail during seismic activity.

Earthquakes may also result in flooding. Flooding may occur if damage occurs to a dam, or dams a drainage or irrigation channel. In addition, earthquakes may cause water waves in water bodies. Such movements in oceans or seas are called tsunamis, not tidal waves. Such movements in inland lakes are called seiches. These waves can be substantial and very destructive to people and property along shorelines.

We now have a good general understanding of earthquakes, and the effects they may cause. It is now appropriate to look at the geologic and seismologic characteristics in and near

Bakersfield so we may take steps to prevent or reduce the loss of life, injuries, and property damage that may result from future earthquakes.

E. LOCAL GEOLOGIC AND SEISMIC CONDITIONS

Earthquakes have been, and will continue to be, a hazard in Bakersfield and Kern County. As the area continues to urbanize, the dangers may be anticipated to increase accordingly.

Qualified geologists are able, to some degree, to anticipate the magnitude of earthquakes which may be expected to occur within varying time frames. It is emphasized that such predictions are only estimates based upon available data. Such estimates, even though they cannot be precise, are of value in determining the degree of risk which the community may reasonably expect.

It is estimated that earthquakes of magnitude 8 to 8.5 may be expected to occur once or twice a century somewhere in Kern County. Although the epicenter of such major earthquakes may be far from the urban area, damage may be anticipated in Bakersfield. Such major earthquakes will probably occur in unpopulated areas, and damage done by them should not be devastating unless they occur within a few miles of a populated area.

The faults which are most likely to effect Kern County with such major earthquakes are as follows:

San Andreas

Garlock

Sierra Nevada

White Wolf

Big Pine

Kern Canyon

Bear Mountain

And perhaps some large faults
buried under the alluvium of
the San Joaquin Valley

The Breckenridge Fault system, and the east and west branches of the Edison Fault are located in the central part of the County, and may be expected to generate earthquakes of magnitude 6 or greater. The determination of the relative degrees of activity of different faults, and the degree of severity of other geologic hazards, are still uncertain. More study and more detailed information will be required before it is possible to more specifically map hazard zones.

In addition, it is estimated that an earthquake of magnitude 6.4 may be anticipated within a 14-mile radius of the center of Bakersfield once every 60 years or so; an earthquake of magnitude 7 may be anticipated once every 200 years or so, and one of magnitude 8 every 1000 years within a 14-mile radius.

Such estimates are only probability predictions, not necessarily dependent on knowledge of active faults proximate to the urban area. From the information received from KernCOG, no active faults are known to exist within the immediate vicinity of the City of Bakersfield that would indicate the need to declare any area as a "Geologic Hazard Area" at this time.

The nearest fault showing movement in historical time is six miles from the center of the City.

"Ground-shaking," as the result of movement of more distant faults in the County or outside the County, is the major danger in Bakersfield. As previously mentioned, the intensity of an earthquake generally decreases with distance from the epicenter. However, in areas with deep sedimentary deposits, strong ground motion may be transmitted over wide areas.

The local area which would be most affected by ground-shaking is probably where the possibility of liquefaction and wet clay soils inhibit support of building foundations. The southeast part of Bakersfield in the vicinity of the sewer farm has a very shallow water table perched above clay beds and may be subject to this effect.

For the most part, the topography of the City consists of gentle slopes, and the hazards of landslides may not generally be anticipated to be substantial. One possible exception to this may be in the vicinity of bluff areas. Landslides in this area are possible if the soil accumulates too much moisture from lawn watering, surface runoff and other means, particularly if strong lateral acceleration due to seismic activity occurs. Erosion, as related to landslides, may also be a consideration in the vicinity of bluffs, and within the Kern River Flood Plain immediately below.

Finally, it is within the realm of possibility that an earthquake could cause the failure of the dam at Lake Isabella.

In October 1969, the U. S. Army Corps of Engineers prepared a study indicating the areas of the City which would be inundated if this occurred, as well as the time which would be available for evacuation. Indeed, the lower lying portions of the City would be flooded if the dam did fail, but there would be sufficient time to evacuate citizens--at least two to three hours from the time of the dam failure.

Knowing we face these potential hazards, what do we do?

F. SEISMIC SAFETY ELEMENT POLICY AND PROGRAM RECOMMENDATIONS

1. Land Use and Site Planning

As previously stated, the "Seismic Hazard Atlas" includes maps which show various geologic features, such as faults, which are useful for purposes of land use and site planning. Fault zones, designated on the maps as shaded areas, may be considered "Geologic Hazard Areas."

We do not now know of any fault systems within the vicinity of Bakersfield which have been so designated. However, future study and the development of more precise information may change this.

Bluff areas may be subject to landslides, and areas near the southeast sewer farm may be subject to liquefaction and subsidence. Special geologic studies should be conducted within these areas to determine the extent of such seismic hazards, if any. If such studies would determine that these areas may be of local geologic concern, the Seismic Hazard Atlas maps covering the Greater Bakersfield areas should be modified accordingly.

It is not recommended, at this time, that special geologic report be required of prospective developers prior to approval of development proposals within these areas. Such an approach would be overly expensive to the private sector, perhaps \$1,000 or more for each potential building site. It is more appropriate for the City to conduct such analytical studies to determine the degree of seismic risk, if any.

If such studies reveal that these areas should be designated as areas of local geologic concern, the City should then prepare specific land use plans. These specific plans would indicate future land uses which would be appropriate considering the degree of seismic risk. Specific plans might also specify any special site development criteria, such as setbacks or engineering and building practices, to minimize the potential of life or property loss resulting from seismic activity.

Finally, plans for redevelopment should be tailored to a Hazard Abatement Plan. Where substantial concentration of dangerous buildings exist, their removal and replacement by modern structures capable of withstanding major earthquakes may be achieved through the redevelopment process.

The existing zoning patterns within the City are consistent with these land use and site planning recommendations;

special amendments to the Zoning Ordinance will not be necessary.

2. The Role of the Building Department

The Building Department must play a crucial role in assuring safety to life and property through investigation and abatement of existing dangerous building conditions, and the enforcement of code and ordinance provisions requiring adequate safety measures in new construction.

a. Hazard Abatement Plan

Generally, existing substandard structures pose the greatest hazard to the community and corrective action to such conditions should be undertaken. There should be an on-going program for an economically feasible yet acceptable level of safety, geared to the degree of structural soundness which the community is willing to support.

A Hazard Abatement Plan should be prepared by the Building Department. This plan would involve the following:

- 1) The establishment of minimum standards of structural adequacy related to seismic risks. Among other things such standards would address requirements for roof diaphragms, parapets, bond beams, wall ties and shear elements.
- 2) An inspection program to evaluate the potential for structural damage that may result from future earthquakes based upon these standards. A priority

listing of buildings would be made which would identify necessary actions. Such action would include the following:

- a) The demolition of dangerous buildings in accordance with a time schedule for abatement. The decision to demolish structures would be based primarily on consideration of estimated costs for reconstruction; if such costs would exceed a predetermined percentage of the value of the building, demolition would be called for. The timetable or priority for demolition would be based upon the nature of the particular occupancy and the hazard the building may present to adjoining occupancies.
- b) The repair or improvement of dangerous buildings where such action would be economically feasible. In addition to the necessary improvements which might be required by the above-cited standards, obvious hazards (such as cornices, parapets, and unsafely anchored signs) would either have to be removed or modified.

The Building Board of Appeals should be given the authority to hear and take action on appeals by individual property owners related to implementation of the Hazard Abatement Plan. The existing Dangerous Building Code would have to be amended to establish

the minimum standards for existing buildings for earthquake.

In developing the Hazard Abatement Plan, all Type "V" (wood frame) buildings not having exterior masonry or concrete walls should be exempt from abatement.

b. New Construction and Code Enforcement

Another major facet of the Building Department's responsibility is the enforcement of codes to assure that new construction results in adequate safety from the hazards of seismic activity.

The Building Department proposes to adopt the 1975 Accumulative Supplement to the Uniform Building Code, specifically Chapter 23. The revised sections reflect the latest design criteria developed by the Structural Engineers Association of California and/or the International Conference of Building Officials Seismology Subcommittee. Chapter 23 includes a revised mathematical formula which considers the types of uses or occupancies and potential movement from seismic activity (both of the building and soil) as the basis for adequate design to resist seismic damage.

The City has already adopted and is enforcing some code provisions to make new construction safer from the standpoint of seismic and geologic risk. Chapter 70 of the 1973 Building Code deals with better excavation and grading controls. Another amendment requires better

reinforcement of concrete footing and slabs in all dwellings and apartment houses. Water pipes are no longer permitted under concrete slabs of buildings to minimize the potential for subsidence should pipes fail. Reports by engineering geologists and soils engineering are required which may require special construction treatment, based upon recommendations within the reports.

A great deal has been done to assure that new construction is safer from seismic and geologic hazards. The City should continue to keep its codes up-to-date in the future.

3. Disaster Contingency Plans

The City of Bakersfield and Kern County Emergency Plan was developed in accordance with the California Emergency Act and Kern County Ordinance No. A-257 of October 3, 1972. The Plan serves as a guide to emergency preparedness and operations, before, during, and after nuclear attack, other types of warfare, and natural disaster, including earthquakes.

It is beyond the scope of the Seismic Safety Element to elaborate upon such contingency plans; more definitive statements regarding such components as evacuation, emergency relief, etc., may be found in the Safety Element of the general plan, also a required element mandated by the California Government Code.

4. Continuing Research

Before engineers and planners will be able to make the best possible recommendations concerning the types and methods of construction and land use planning, it will be necessary to know more about the effects of shaking of earthquakes. State and local governments should continue to support research on geologic hazards, and should encourage the Federal Government to do the same. Of utmost importance is the program of installing and maintaining strong motion seismographs throughout the country.

The Building Department in accordance with State law now requires earthquake recording instruments in certain buildings. Three buildings within the City now have accelerographs. The Building Department is also seeking aid from Cal State Bakersfield, Bakersfield College, and City Personnel, to undertake an on-going program of seismic safety study involving:

- a. Maintenance of accelerographs.
- b. Interpretation and dispersion of recordings.
- c. Further education on seismic effects and research.
- d. Expansion of activities.

Following a few more strong earthquakes, with instruments at a variety of distances from the causative fault and on a variety of soil and rock types, it will be possible to set forth more realistic standards so that the intensity, duration, and frequency of shaking can be specified for the

type of earthquake likely to occur within a given locality. Without this information it is difficult to design structures correctly and the only assurance of safety is costly overdesign.

With this information, and with further study into the techniques of earthquake resistant design, it will be possible to prepare, enact, and enforce codes related to earthquake safety which are not based upon building lore, but based upon the latest state of the art in construction.

For this to be possible, on-going research is necessary.

5. What People Can Do For Themselves

As with many things, some of the most positive steps to minimize the disastrous effects of earthquakes rests with people helping themselves. What is needed is an educational program to inform people what they can do before, during, and after an earthquake. The responsibility for such an educational program should not only be assumed by educational institutions in the community, but also the media, and you--the citizens of Bakersfield.

Cited below are a few Earthquake Safety Tips: Pass Them On!.

BEFORE

- a. Store emergency supplies, food, water, first aid kit, flashlight and battery powered radio.
- b. Take a practical first aid course.

- c. Locate main switches and valves that control the flow of water, gas and electricity into your home. Know how to operate them; tie a wrench to the gas meter.
- d. Bolt down heavy furniture above the fifth floor of tall buildings.
- e. Place guard rails across the inside of plate glass windows that extend to the floor in tall buildings.
- f. Support local programs intended to make you safer from the hazards of earthquakes.

DURING

- a. Don't panic, even if you are frightened.
- b. If you are indoors, stay there. Get under a desk, table or doorway.
- c. Do not rush outside. Falling debris has caused many deaths.
- d. If you are outside, move away from buildings and power lines; stay in the open.
- e. If you are in a moving car, stop as soon as it is safe. Stay in the car.

AFTER

- a. Check your family, or the people near you for injuries.
- b. Inspect your utilities for damage to water, gas, or electrical conduits. If they are damaged, turn them off.
- c. Extinguish open flames.

- d. Do not use the telephone except to report an emergency.
- e. Turn on your battery powered radio for emergency information.
- f. Don't go sightseeing. If the damage is substantial, you will have plenty of time to see it.
- g. Stay away from damaged structures; after shocks can cause their collapse if they have been weakened.

U.C. BERKELEY LIBRARIES



C101738914